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ABSTRACT

A study assessed the relationship of weight reduction to the strength of various muscle groups in conjunction with a pre-season and in-season training and conditioning program. Twenty-nine high school wrestlers, with an average age of 15 years 4 months, significantly reduced their body weight. In the process, there were losses in lean body weight. At the end of the 13-week season, there were significant losses in body strength, especially in the larger muscle groups of the legs. The fact that these decrements in strength occurred while maintaining a weight training and vigorous exercise routine is particularly significant and has serious implications concerning the training program of the high school wrestler. It may be more advantageous not to reduce body weight, but rather maintain body weight (unless one is obviously overweight) and increase muscular strength. (JD)

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THE EFFECT OF WEIGHT REDUCTION ON BODY COMPOSITION AND STRENGTH IN HIGH SCHOOL WRESTLERS

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ABSTRACT

This study was done to assess the relationship of weight reduction to the strength of various muscle groups in conjunction with a pre-season and in-season training and conditioning program. Twenty-nine high school wrestlers, with an average age of 16 years 4 months, significantly reduced their body weight. In the process, there were losses in lean body weight. The correlation between the loss of body weight and the loss of lean body weight was found to be +.47. At the end of the 13 week season, there were significant losses in body strength, especially in the larger muscle groups of the legs. In summary, the sample experienced a reduction in which body weight accompanied by a loss of lean body weight, which resulted in the loss of body strength of certain muscle groups.

INTRODUCTION

The purpose of this investigation is to conduct an analysis of the effect of changes in body weight, body fat, and lean body weight on muscular strength. The study was carried out by observing a group of high school wrestlers in a successful high school program, who reduced their body

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weight while maintaining a vigorous weight training and conditioning program.

Wrestling is a sport in which opponents of equal weight are matched and all other factors being equal, the wrestler who possesses greater strength will have an advantage. Therefore, a training program designed to minimize body weight while simultaneously improving body strength through weight training and conditioning would be a major objective for insuring successful performance.

However, evidence indicates that when weight is reduced; it may not be limited exclusively to unwanted fat weight. Weight loss is attributed to a combination of fat tissue, body fluids, and lean body tissue. The lean body tissue is comprised of both organ weight and valuable muscle weight. Studies done on weight reduction indicate that when physical exercise is performed while losing weight, there tends to be relatively less lean body weight loss. (1,2,3,4) Individuals who are sedentary and lose weight solely by restricting caloric intake will lose relatively more lean body weight. (5,6)

METHODS AND MATERIALS

Twenty-nine high school wrestlers, each having at least one year of competitive high school wrestling experience, participated in this study. Immediately prior to the beginning of the pre-season training program, several measurements were taken: body weight; percent body fat; lean body weight; and eight strength measurements representing all major

muscle groups. The pre-season weight training and conditioning program lasted for a total of three weeks. At that time, the training program was restructured, accommodating the competitive schedule. This period of time was approximately ten weeks. At the end of the regular competitive schedule (13 weeks) each wrestler was reevaluated and a comparison was made with each wrestler's pre-test values.

Subjects were counseled by their coaches as to proper eating habits before and especially during the season. Attention was devoted to caloric intake and caloric expenditure, however, there was no restriction of specific food types adhered to by the subjects in this study and no record was made by coaches or investigators regarding their diets. Extensive weight reduction was discouraged.

Percent body fat and lean body weight were determined through hydrostatic weighing. (7) (8) Vital capacity was determined through spirometry and residual volume was estimated according to the technique as outlined by Consolazio, et al. (9) Following the procedures recommended by Wilmore, (10) either the highest obtained weight was recorded, if observed more than once, or the second highest obtained weight if it was observed more than once, or an average between the heaviest two observed weights was used.

Strength evaluation consisted of eight tests selected on the basis that they represent all major muscle groups. (11) Tests for chest and shoulder strength were done on Hydra Gym machines. Two warm-up trials were per-

mitted before a maximal effort was recorded. (12)

Strength of the quadriceps and hamstring muscles are measured on a Cybex Orthotron. At a rate of 30° per second, maximal contractions were recorded after two warm-up trials. Subjects performed three maximal effort contractions in flexion and extension at the knee with the highest values in foot pounds being recorded. Both dominant and non-dominant legs were measured.

Hand grip was measured using a Jamar Hand Dynamometer. After instruction the subject was given one trial with each hand. The hand was held in front of the body at waist level with the elbow flexed 90° and positioned against the body.

The weight training and conditioning program was designed to increase muscular strength and develop the cardiovascular system while reducing body weight in order to reach the certified weight for the intended weight classification. The weight training program which included at least one exercise for each major muscle group, plus additional exercises, were designed to strengthen muscles specific to wrestling.

The weight training and conditioning exercises were intedned to promote fatigue with each set of eight to twelve repetitions for the upper body and 12 to 20 repetitions for the lower body. (13) The subjects were instructed to move immediately to the next station in the circuit after completing each exercise so as to help promote cardiovascular development.

Three sets were completed with each weight training workout.

Running during the early part of the season emphasized longer distances while later into the season, shorter anaerobic runs of 220 yards or less were done.

RESULTS

As a result the pre-season and in-season training program, the wrestlers experienced a significant mean weight loss of 6.4 pounds. (Table 1)

Changes in percent body fat and lean body weight were highly variable. Several wrestlers actually gained in percent body fat while losing primarily lean body weight and, coversely, others lost a considerable amount of body fat while gaining in lean body weight. In fact, as a group the mean lean body weight loss was 7.0 pounds, even more than the total body weight loss. But because of the increase in the variability of the lean body weight scores, it was not found to be statistically significant.

Strength scores were analyzed to determine whether there were any significant gain or loss in body strength. It was found that mean strength scores decreased in seven out of the eight tests and a significant decrease was observed in five out of eight tests; shoulder strength, (Figure 3) dominant and non-dominant leg curls (Figure 4). Only in the test for dominant hand grip was there an increase in the mean strength score and improvement was not significant (See Figure 1).

The Pearson Product-Moment Coefficient of Correlation was computed to determine the relationship between weight change and lean body weight change. (See Figure 5) An $r = +.47$ was determined, indicating that those wrestlers who experienced the greatest weight loss, also experienced the greater amount of lean body weight loss. In the sample there were 3 wrestlers who gained weight, and they all gained in lean body weight and had improved strength scores. Also, in the sample, there were only 3 wrestlers who experienced a body weight loss accompanied by a lean body weight gain. One wrestler, a state champion, maintained his body weight and he experienced an 8 pound gain in lean body weight.

DISCUSSION

The loss of excess body weight is felt to be important in the high school wrestler for two major reasons. First, excess weight does not contribute to the effort involved in competition and actually demands a certain proportion of the total energy output. Secondly, wrestling in a lower weight classification without experiencing a loss of body strength should enhance the chances for successful performance. Therefore, the wrestler seeks to keep his weight at a minimum while maintaining or improving his strength. Most wrestling programs attempt to accomplish this objective by combining a reduced caloric intake with an intensive exercise program that includes weight training and vigorous practice. This sample of 29 high school wrestlers attempted to achieve this goal. As expected with the loss of lean body weight, there were significant losses in strength

Apparently, the loss of lean body weight affected the larger muscle groups of the legs, to a greater degree.

Strength scores of the sample significantly decreased in five of the eight tests, including all four leg strength tests (see Figures 4 and 3) and shoulder strength (see Figure 3). Chest strength and grip strength did not significantly change. The fact that these decrements in strength occurred while maintaining a weight training and vigorous exercise routine is particularly significant and has serious implications concerning the training program of the high school wrestler.

It may be more advantageous not to reduce body weight, but rather maintain body weight (unless one is obviously overweight) and increase muscular strength.

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TABLE 1. DIFFERENCES IN BODY WEIGHT AND LEAN BODY WEIGHT FROM PRE SEASON TO POST SEASON (13 WEEKS N=29)

		MEAN	SE	t
BODY WEIGHT	PRE	146.7		
	POST	140.3		
	DIFFERENCE	6.4	.73	2.11 *
LEAN BODY WEIGHT	PRE	126.3		
	POST	119.3		
	DIFFERENCE	7.0	1.6	1.79

SIGNIFICANT ($p < .05$)

FIG. 1 CHANGES IN GRIP STRENGTH

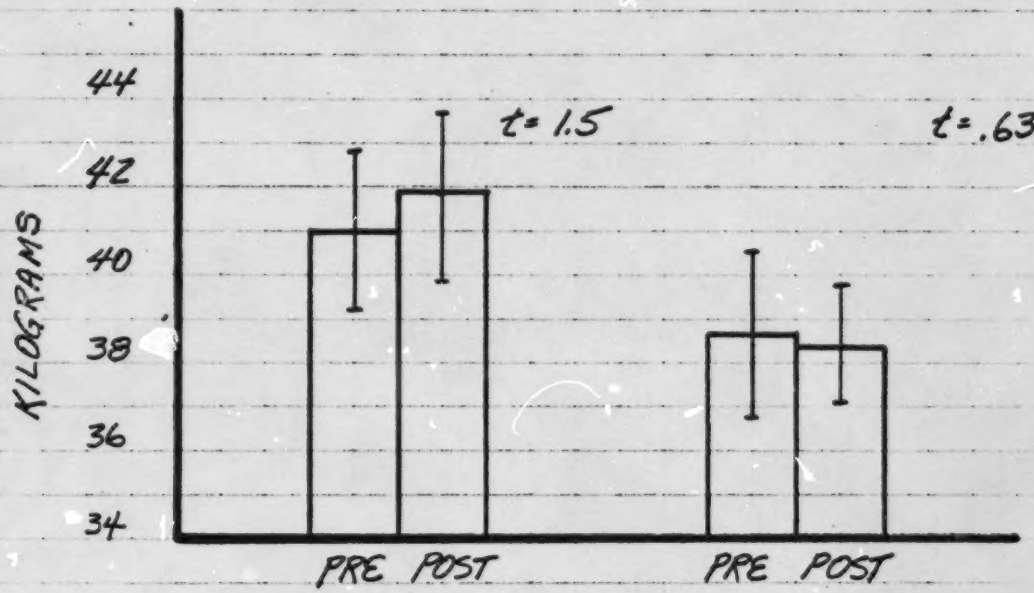
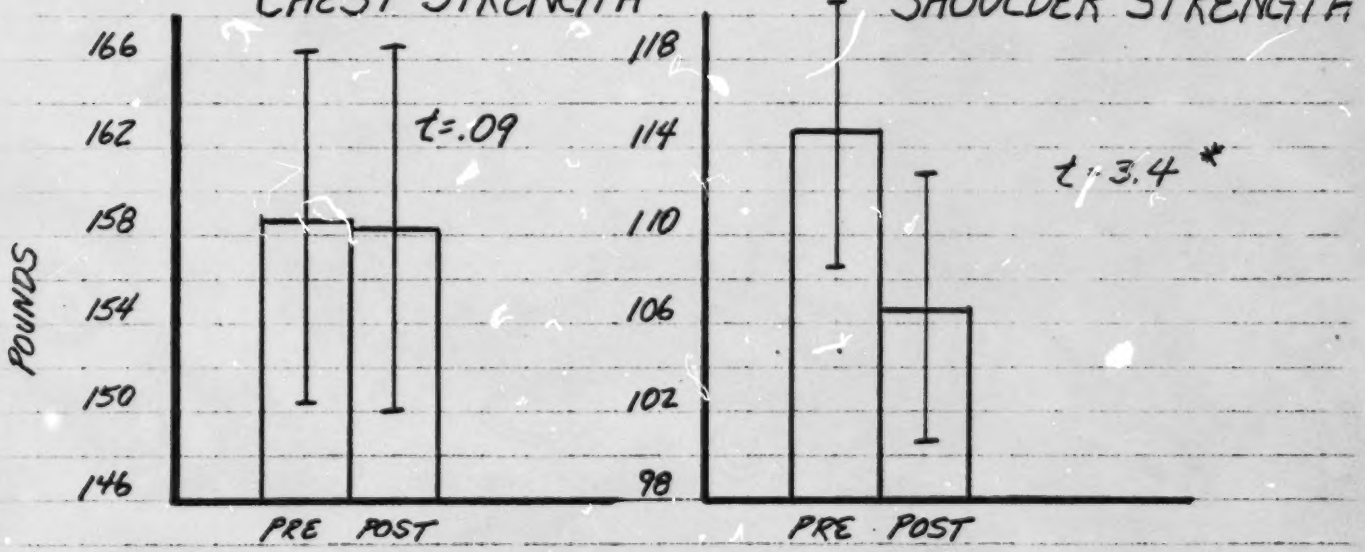


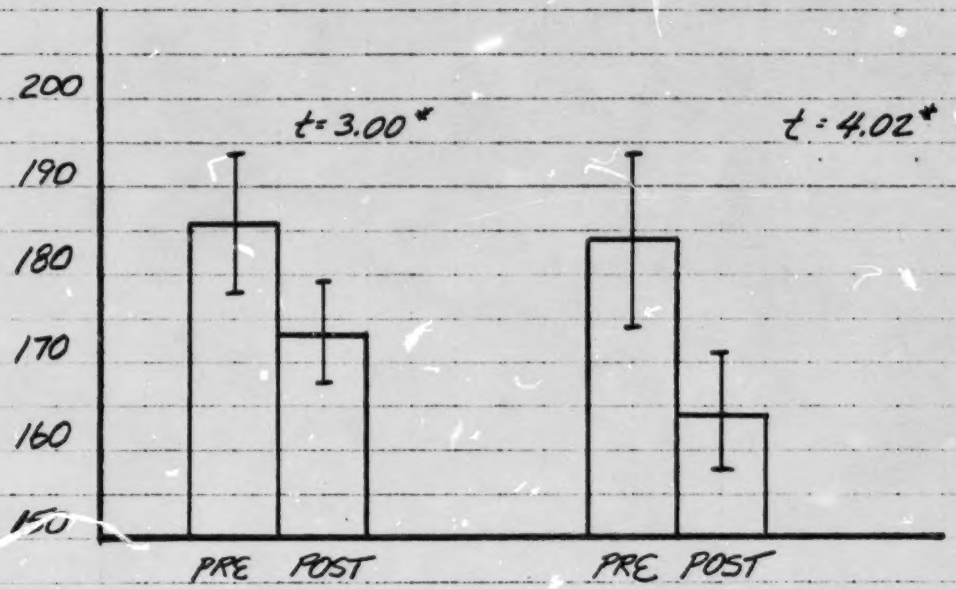
FIG. 2 CHANGES IN CHEST STRENGTH

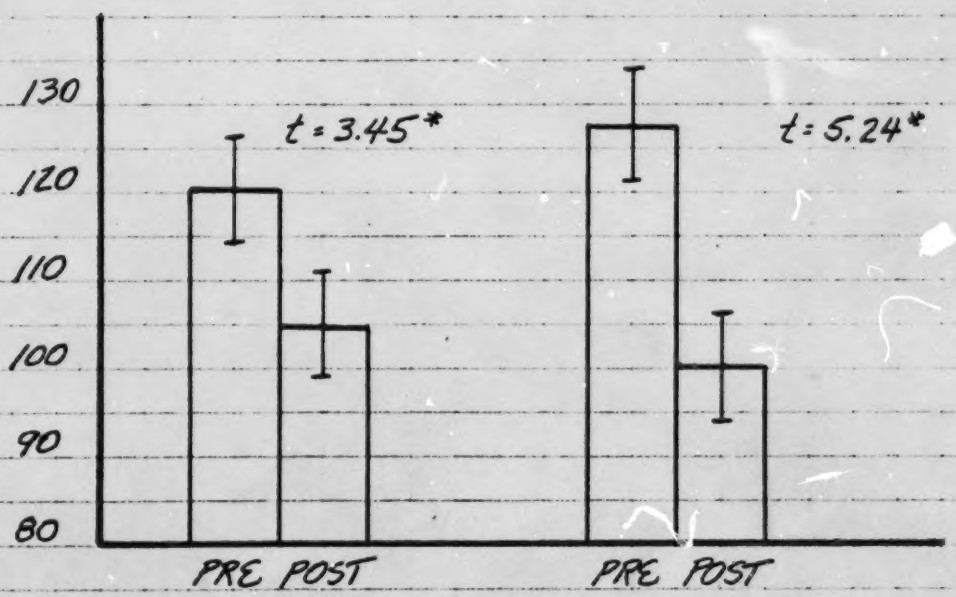
FIG. 3 CHANGES IN SHOULDER STRENGTH



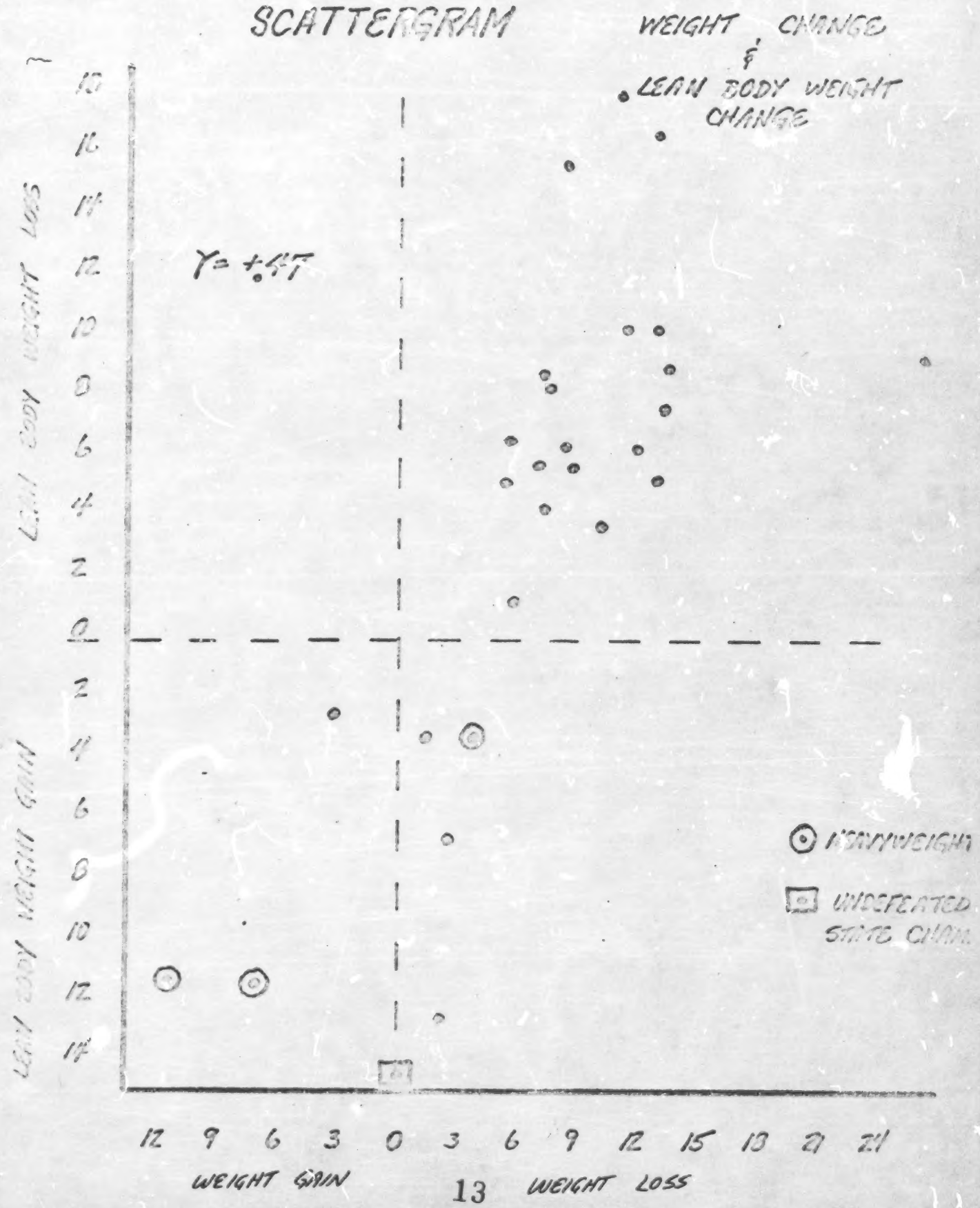
* SIGNIFICANT ($p < .05$)

FIG. 4 CHANGES IN LEG STRENGTH





SIGNIFICANT ($p < .05$)


SCATTERGRAM
WEIGHT CHANGE & LEAN BODY WEIGHT CHANGE
Y= +.47
LEAN BODY WEIGHT LOSS
LEAN BODY WEIGHT GAIN
10
8
6
4
2
0
2
4
6
8
10
12
14
12 9 6 3 0 3 6 9 12 15 18 21 24
WEIGHT GAIN
WEIGHT LOSS
UNDEFEATED STATE CHAM